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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Logan, et al.
Serial No.	10/025,097
Filed:	12/19/2001
Group Art Unit:	2837
Examiner:	Salata, Anthony J.
Title:	LOAD BEARING MEMBER FOR USE IN AN ELEVATOR SYSTEM HAVING EXTERNAL MARKINGS FOR INDICATING A CONDITION OF THE ASSEMBLY

PETITION TO WITHDRAW NOTICE OF ABANDONMENT

Box AF
Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Pursuant to 37 C.F.R. 1.81, Applicant hereby petitions to have the Notice of Abandonment mailed on August 19, 2003 to be withdrawn. On June 18, 2003 a Request for Continued Examination was filed. Attached to this Petition is a copy of the Request for Continued Examination along with the submissions accompanying that Request.

Accordingly, Applicant filed the Request for Continued Examination before the Issue Fee was due for this application and the application should not have been considered abandoned. Applicant respectfully requests that the Notice of Abandonment be withdrawn.

Applicant believes that no additional fees are necessary, however, the Commissioner is authorized to charge Deposit Account No. 50-1482 in the name of Carlson, Gaskey & Olds for any additional fees or credit the account for any overpayment.

Respectfully submitted,

CARLSON, GASKEY & OLDS

David J. Gaskey
Registration No. 37,139
400 W. Maple, Suite 350
Birmingham, MI 48009
(248) 988-8360

Dated: August 28, 2003

CERTIFICATE OF MAILING

I hereby certify that the enclosed PETITION TO WITHDRAW NOTICE OF ABANDONMENT is being deposited with the United States Postal Service as First Class Mail, postage prepaid, in an envelope addressed to Box AF, Commissioner for Patents, P. O. Box 1450, Alexandria, VA 22313-1450 on August 28, 2003.

Theresa M. Palmateer

N:\Clients\OTIS ELEVATOR\IP00052\PATENT\Petition to Withdraw Notice of Abandonment.doc

Carlson, Gaskey & Olds, P.C.

ASSISTANT COMMISSIONER OF PATENTS

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PATENTS

Inventor / Applicant: Loan et al

Date: 9-18-03 Attorney: JJG File No.: 60,469-05-2

☐ New Patent Application:

☐ CON ☐ CIP ☐ DIV ☐ Provisional ☐ PCT

____ Page(s) Specification

____ Page(s) Claims

____ Page(s) Abstract

____ Sheets of Drawings (formal/informal)

☐ Transmittal Sheet
☑ IDS
☐ Assignment
☐ Certificate of Express Mail
☑ Response / Amendment

☐ Executed Declaration & Power of Attorney
☐ PTO 1449
☐ Recordation Cover Sheet
☑ Notice of Appeal
☐ Extension of Time

☐ Small Entity Declaration
☑ Patent Copies - 4
☐ Fee Calculation Sheet
☐ Appeal Brief

☐ Issue Fee Transmittal
☐ Certificate of Correction

☐ Change of Fee Address
☐ Priority Document

☐ Make of Record Letter
☐ Maintenance Fee Transmittal

☐ PCT Request

☐ General Power of Attorney

☐ Response to Invitation

Other: Credit Card Payment Form
Requesting Continued Examination
& Card

Fee: $ ____ Serial / Patent No.: 10/057,093

Carlson, Gaskey & Olds, P.C.

ASSISTANT COMMISSIONER OF PATENTS

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PATENTS

Inventor / Applicant: Loan et al

Date: 9-18-03 Attorney: JJG File No.: 60,469-05-2

☐ New Patent Application:

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☐ General Power of Attorney

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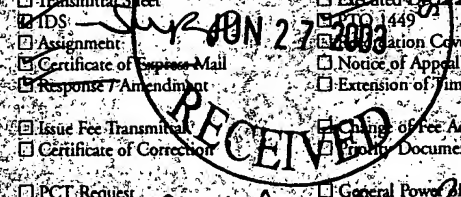
Other: Credit Card Payment Form
Requesting Continued Examination
& Card

Fee: $ ____ Serial / Patent No.: 10/057,093



PTO/SB/30 (08-00)
Approved for use through 10/31/2002. OMB 0651-0031
U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
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REQUEST FOR CONTINUED EXAMINATION (RCE) TRANSMITTAL

Subsection (b) of 35 U.S.C. § 132, effective on May 29, 2000, provides for continued examination of an utility or plant application filed on or after June 8, 1995. See The American Inventors Protection Act of 1999 (AIPA).

Application Number	10/025,097
Filing Date	12/19/2001
First Named Inventor	Logan, et al.
Group Art Unit	2837
Examiner Name	Salata, Anthony J.
Attorney Docket Number	60469-052; OT-4935

This is a Request for Continued Examination (RCE) under 37 C.F.R. § 1.114 of the above-identified application.

NOTE: *37 C.F.R. § 1.114 is effective on May 29, 2000. If the above-identified application was filed prior to May 29, 2000, applicant may wish to consider filing a continued prosecution application (CPA) under 37 C.F.R. § 1.53 (d) (PTO/SB/29) instead of a RCE to be eligible for the patent term adjustment provisions of the AIPA.* See *Changes to Application Examination and Provisional Application Practice*, Final Rule, 65 *Fed. Reg.* 50092 (Aug. 16, 2000); Interim Rule, 65 *Fed. Reg.* 14865 (Mar. 20, 2000), 1233 *Off. Gaz. Pat. Office* 47 (Apr. 11, 2000), which established RCE practice.

1. **Submission required under 37 C.F.R. § 1.114**
   - a. ☐ Previously submitted
     - i. ☐ Consider the amendment(s)/reply under 37 C.F.R. § 1.116 previously filed on _____ (Any unentered amendment(s) referred to above will be entered).
     - ii. ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____
     - iii. ☐ Other _____
   - b. ☑ Enclosed
     - i. ☑ Amendment/Reply
     - ii. ☐ Affidavit(s)/Declaration(s)
     - iii. ☐ Information Disclosure Statement (IDS)
     - iv. ☑ Other Supp. Information Disclosure Statement

2. **Miscellaneous**
   - a. ☐ Suspension of action on the above-identified application is requested under 37 C.F.R. § 1.103(c) for a period of _____ months. (Period of suspension shall not exceed 3 months; Fee under 37 C.F.R. § 1.17(i) required)
   - b. ☐ Other _____

3. **Fees** The RCE fee under 37 C.F.R. § 1.17(e) is required by 37 C.F.R. § 1.114 when the RCE is filed.
   - a. ☐ The Director is hereby authorized to charge the following fees, or credit any overpayments, to Deposit Account No._____
     - i. ☐ RCE fee required under 37 C.F.R. § 1.17(e)
     - ii. ☐ Extension of time fee (37 C.F.R. §§ 1.136 and 1.17)
     - iii. ☐ Other _____
   - b. ☐ Check in the amount of $_____ enclosed
   - c. ☑ Payment by credit card (Form PTO-2038 enclosed)

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

Name (Print/Type)	David J. Gaskey	*Registration No. (Attorney/Agent)*	37,139
Signature		*Date*	June 18, 2003

CERTIFICATE OF MAILING OR TRANSMISSION

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner For Patents, Box RCE, Washington, DC 20231, or facsimile transmitted to the U.S. Patent and Trademark Office on:

Name (Print/Type)	Theresa M. Palmateer		
Signature		*Date*	June 18, 2003

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND Fees and Completed Forms to the following address: Assistant Commissioner for Patents, Box RCE, Washington, DC 20231.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application:	Logan, et al.
Serial No.:	10/025,097
Filed:	12/19/2001
Group Art Unit:	2837
Examiner:	Salata, Anthony J.
For:	LOAD BEARING MEMBER FOR USE IN AN ELEVATOR SYSTEM HAVING EXTERNAL MARKINGS FOR INDICATING A CONDITION OF THE ASSEMBLY

AMENDMENT

Box AF
Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

This paper is submitted with a Request for Continued Examination. Please amend the application as follows:

IN THE CLAIMS:

Please make the following changes to the claims.

1. (Original) A load bearing assembly for use in an elevator system, comprising:

a plurality of elongated load bearing members;

a jacket at least partially enclosing the load bearing members; and

a plurality of detectable markings longitudinally spaced on at least one side of the jacket, the markings being at a first spacing along the side of the jacket when the assembly is in a first condition, the spacing between at least two of the markings changing responsive to a change in the condition of the assembly.

2. (Original) The assembly of claim 1, wherein the markings are optically detectable.

3. (Original) The assembly of claim 1, wherein the markings comprise indentations on the side of the jacket.

4. (Original) The assembly of claim 1, wherein the markings are spaced with a controlled spacing between sets of adjacent markings.

5. (Original) The assembly of claim 1, wherein the markings include a first plurality of first markings and a second plurality of second markings, the first markings being spaced relative to each other and the second markings being spaced relative to each other.

6. (Original) The assembly of claim 5, wherein the first markings have a first configuration and the second markings have a second configuration that is different from the first configuration.

7. (Original) The assembly of claim 5, wherein the first markings are spaced from each other longitudinally along the jacket and the second markings are spaced from each other longitudinally along the jacket and laterally offset from the first markings.

8. (Original) The assembly of claim 1, wherein the jacket comprises a first color and the markings are painted on the jacked and comprise a second color.

9. (Original) A method of making a load bearing assembly for use in an elevator system, comprising:

arranging a plurality of load bearing members in a selected alignment;

placing the load bearing members at least partially within a jacket; and

placing a plurality of markings longitudinally spaced on at least one side of the jacket such that the markings are spaced at a first spacing when the assembly is in a first condition and the spacing between at least two of the markings changes responsive to a change in the condition of the assembly.

10. (Original) The method of claim 9, including using a laser to apply the markings to the jacket.

11. (Original) The method of claim 9, including forming the jacket from a first material having a first property and making the markings by applying a second material to the jacket that has a second property that is distinct from the first material property.

12. (Original) The method of claim 9, including painting the markings on the jacket.

13. (Original) The method of claim 9, including placing a first plurality of markings having a first spatial relationship with each other and placing a second plurality of markings on the jacket having a second spatial relationship with each other.

14. (Original) The method of claim 9, including controlling the spacing between adjacent ones of the markings.

15. (Original) The method of claim 15, including using two lasers to apply pairs of the markings, the lasers being at a controlled spacing.

16. (Original) A method of determining a condition of a load bearing assembly in an elevator system having a plurality of load bearing members within a jacket that includes detectable markings on at least one side of the jacket, comprising the steps of:

determining a current spacing between at least two of the markings; and

determining a current condition of the assembly using the current spacing of the markings.

17. (Original) The method of claim 16, including determining a baseline spacing under a controlled assembly load condition and using the baseline spacing and the current spacing to determine the current condition.

18. (Original) The method of claim 16, including determining a torque of a motor associated with the elevator system that provides a motive force to move the load bearing assembly and using the motor torque and the current spacing to determine the current condition.

19. (Original) The method of claim 16, including determining a change in spacing between selected ones of the markings along the length of the assembly, determining a changing in a load on the assembly and determining whether the determined change in spacing corresponds to the determined changing load.

20. (Currently Amended) A device for inspecting a load bearing assembly in an elevator system, comprising:

a detector that gathers information regarding spacing between external markings on the load bearing assembly; and

a controller that utilizes the spacing information gathered by the detector and makes a determination regarding a load bearing condition of the load bearing assembly.

21. (Currently Amended) A device for inspecting a load bearing assembly in an elevator system, comprising:

a detector that gathers information regarding spacing between at least two ~~of~~ markings on the load bearing assembly; and

a controller that uses the spacing information to make a determination regarding a load gearing condition of the load bearing assembly.

22. (Previously added) The device of claim 21, wherein the controller accounts for a change in a load on the assembly and determines whether a change in spacing between selected ones of the markings corresponds to the change in the load.

23. (New) The device of claim 20, wherein the controller determines an amount of degradation of the load bearing assembly.

24. (New) The device of claim 20, wherein the controller determines an amount of stretch of the load bearing assembly.

25. (New) The device of claim 20, wherein the controller accounts for a change in a load on the assembly and determines whether a change in spacing between selected ones of the markings corresponds to the change in the load.

26. (New) A device for inspecting an elevator system load bearing assembly that has a plurality of tensile members encased within a jacket, comprising:

a detector that gathers information regarding spacing between external markings on the jacket of the load bearing assembly; and

a controller that utilizes the spacing information gathered by the detector and makes a determination regarding a condition of the load bearing assembly.

27. (New) The device of claim 26, wherein the controller determines an amount of stretch of the load bearing assembly.

28. (New) The device of claim 26, wherein the controller determines a degradation of the load bearing assembly.

29. (New) The device of claim 26, wherein the controller accounts for a change in a load on the assembly and determines whether a change in spacing between selected ones of the markings corresponds to the change in the load.

30. (New) The device of claim 26, wherein the controller uses spacing information regarding spacing between at least two of the markings to make the determination regarding the condition of the load bearing assembly.

REMARKS

Applicant respectfully requests continued examination of this application. Claims 1-22 were allowed. Claims 1-19 remain as originally presented. Claims 20 and 21 are amended. New claims 23-30 are presented.

Applicant respectfully requests continued examination of this application and the Examiner's consideration of the references provided in the enclosed Information Disclosure Statement.

Applicant respectfully submits that this case is in condition for allowance.

Payment for the Request for Continued Examination and the additional claims is made by the enclosed authorization to charge a credit card.

Respectfully submitted,

CARLSON, GASKEY & OLDS

By: _____

David J. Gaskey, Reg. No. 37,139
400 W. Maple Rd., Ste. 350
Birmingham, MI 48009
(248) 988-8360

Dated: June 18, 2003

N:\Clients\OTIS ELEVATOR\IP00052\PATENT\Amendment 6-17-03.doc

CERTIFICATE OF MAILING

I hereby certify that the enclosed Amendment is being deposited with the United States Postal Service as First Class Mail, postage prepaid, in an envelope addressed to Commissioner for Patents, P. O. Box 1450, Alexandria, VA 22313-1450 on June 18, 2003.

Theresa M. Palmateer

PTO-2038 (02-2000)
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United States Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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SEP 0 2 2003

United States Patent & Trademark Office

Credit Card Payment Form

Please Read Instructions before Completing this Form

Credit Card Information

Credit Card Type:	(Visa) MasterCard American Express Discover
Credit Card Account #:	[redacted]1022
Credit Card Expiration Date:	12/05
Name as it Appears on Credit Card:	US Patent and Trademark Office
Payment Amount: $(US Dollars)	$978.00
Signature:	Date: June 18, 2003

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Service Charge: There is a 50.00 service charge for processing each payment refused (including a check returned "unpaid") or charged back by a financial institution (37 CFR 1.21(m)).

Credit Card Billing Address

Street Address 1:	c/o Otis Elevator Company		
Street Address 2:	10 Farm Springs		
City:	Farmington		
State:	CT	Zip/Postal Code:	06032
Country:	USA		
Daytime Phone #:	860-676-5742	Fax #:	860-676-5766

Request and Payment Information

Description of Request and Payment Information:

RCE filing fee; 8 new claims; 1 new independent claim

Patent Fee	Patent Maintenance Fee	Trademark Fee	Other Fee
Application No. 10/025,097	Application No.	Serial No.	IDON Customer No.
Patent No.	Patent No.	Registration No.	
Attorney Docket No. OT-4935; 60469-052		Identify or Describe Mark	

If the cardholder includes a credit card number on any form or document other than the Credit Card Payment Form, the United States Patent & Trademark Office will not be liable in the event that the credit card number becomes public knowledge.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Logan, et al.
Serial No.	10/025,097
Filed:	12/19/2001
Group Art Unit:	2837
Examiner:	Salata, Anthony J.
Title:	LOAD BEARING MEMBER FOR USE IN AN ELEVATOR SYSTEM HAVING EXTERNAL MARKINGS FOR INDICATING A CONDITION OF THE ASSEMBLY

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT

Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

Complying with Applicant's duty of disclosure, Applicant encloses a copy of a search report received from a corresponding foreign patent application. Pursuant to 37 C.F.R. 1.97(e)(1), each item of information contained in the Information Disclosure Statement was **first** cited in any communication from a foreign patent office in a counterpart foreign application not more than three (3) months prior to the filing of the Information Disclosure Statement.

The enclosed Form PTO 1449 lists the references cited in the search report. Copies of those references are enclosed.

Applicant does not have a full translation of the European Patent document 0 103 162. Applicant encloses an English abstract of that document for the Examiner's consideration. Based upon that abstract and the drawings, Applicant believes that that document does not teach an arrangement that detects a load bearing condition of a rope, but

instead is limited to speed or position information regarding movement of the rope. Additionally, Applicant believes that that document does not disclose external markings on a jacket encasing tensile members in a load bearing assembly.

Applicant respectfully requests that the Examiner consider the enclosed and make the cited references of record in this application.

Respectfully submitted,

CARLSON, GASKEY & OLDS

David J. Gaskey
Reg. No 37,139
400 W. Maple Rd., Ste. 350
Birmingham, MI 48009
(248) 988-8360

Dated: June 18, 2003

CERTIFICATE OF MAILING

I hereby certify that the enclosed **Supplemental Information Disclosure Statement** is being deposited with the United States Postal Service as First Class Mail, postage prepaid, in an envelope addressed to Box AF, Commissioner for Patents, P. O. Box 1450, Alexandria, VA 22313-1450 on June 18, 2003.

Theresa M. Palmateer

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PTO/SB/08A (10-01)
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Substitute for form 1449A/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(use as many sheets as necessary)

Sheet 1 of 2

Complete If Known	
Application Number	10/025,097
Filing Date	12/19/2001
First Named Inventor	Logan, et al.
Art Unit	2837
Examiner Name	Salata, Anthony J.
Attorney Docket Number	60469-052; OT-4935/4941

U.S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number - Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		US- 6,073,728	06-13-2000	Olsen, et al.	
		US-			
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FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3] -Number[4] - Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T[6]
		EP 0 103 162 A2	03-21-1984	Bauer Gerhard Dipl-Ing		

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST. 16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

Please type a plus sign (+) inside this box → [+]

PTO/SB/08B (08-00)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(use as many sheets as necessary)

Sheet 2 of 2

Complete If Known	
Application Number	10/025,097
Filing Date	12/19/2001
First Named Inventor	Logan, et al.
Group Art Unit	2837
Examiner Name	Salata, Anthony J.
Attorney Docket Number	60469-052; OT-4935/4941

OTHER PRIOR ART – NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
		Wire ropes and new suspension means XP-001092527; Lift-Report 27.Jahrg. (2001) Heft 5 (September/Oktober 2001)	
		PCT International Search Report mailed 25/04/2003 (PCT/US 02/40242)	

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] Unique citation designation number. [2] Applicant is to place a check mark here if English language Translation is attached.

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Measuring and control device for loads suspended from cables, in particular for lifting stage settings.

Patent Number: EP0103162
Publication date: 1984-03-21

Inventor(s): BAUER GERHARD DIPL-ING
Applicant(s): BAYERISCHE BUEHNENBAU GMBH (DE)

Requested Patent: ☐ EP0103162, A3, B1
Application Number: EP19830107865 19830809
Priority Number(s): DE19823230213 19820813
IPC Classification: B66C13/46; A63J1/02
EC Classification: B66C13/46, A63J1/02H, B66B5/14B, G01B11/04B
Equivalents: ☐ DE3230213
Cited Documents: DE1030982; FR1438839; DE2649370

Abstract

1. A measuring and control device for loads suspended from cables, in particular for lifting stage settings, comprising a winding drum, first measuring means for detecting the angular position and/or the rotational speed of the winding drum, a motor for driving the winding drum, second measuring means (21...24) for scanning optical marks (11...14) provided on the cable (10), an analyzer (30) for comparing the measured results from both measuring means, and a control unit for controlling the motor in response to predetermined set-point values of paid-out cable length and the measured actually paid-out cable length, characterized in that the second measuring means includes a plurality of optical sensors, (21...24), the spacing (1+n DELTA l) between said sensors being selected such that not more than two sensors will simultaneously detect a cable mark (11).

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Veröffentlichungsnummer: **0 103 162**
A2

(12) EUROPÄISCHE PATENTANMELDUNG

(21) Anmeldenummer: 83107865.4

(22) Anmeldetag: 09.08.83

(51) Int. Cl.³: B 66 C 13/46, A 63 J 1/02

(30) Priorität: 13.08.82 DE 3230213

(43) Veröffentlichungstag der Anmeldung: 21.03.84
Patentblatt 84/12

(84) Benannte Vertragsstaaten: AT BE CH DE FR IT LI NL SE

(71) Anmelder: Bayerische Bühnenbau GmbH, Am Forst 17, D-8480 Weiden/Opf. (DE)

(72) Erfinder: Bauer, Gerhard, Dipl.-Ing., Am Schlesslweiher, D-8481 Schwarzenbach (DE)

(74) Vertreter: von Bülow, Tam Axel Hans-Werner Dr. Dipl.-Ing., Dipl.-Wirtsch.-Ing. et al, Postfach 86 06 24 Widenmayerstrasse 48, D-8000 München 22 (DE)

(54) **Mess- und Steuereinrichtung für an Seilen befestigte Lasten, insbesondere für Theaterpunktzüge.**

(57) Die Meß- und Steuereinrichtung für an Seilen befestigte Lasten, insbesondere für Theaterpunktzüge, besitzt eine erste Meßeinrichtung (36, 45), die die Winkelstellung einer Seiltrommel, an welcher das Seil befestigt ist, erfaßt. Eine zweite Meßeinrichtung, die optische Markierungen (11) des Seiles (10) abtastet, besitzt mehrere optische Meßfühler (21, 22, 23, 24), deren Abstände so gewählt sind, daß gleichzeitig maximal zwei Seilmarkierungen erfaßt werden. Die Meßergebnisse beider Meßeinrichtungen werden in einer Auswerteeinrichtung (30) miteinander verknüpft, zur hochgenauen Ermittlung der tatsächlich ausgefahrenen Seillänge unter Berücksichtigung der Seildehnung.

EP 0 103 162 A2

MEISSNER & BOLTE
Patentanwälte · European Patent Attorneys
Bremen* · München**

0103162

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		M/BBB-15-DE	12.8.1982 vB/LÖ

Meß- und Steuereinrichtung für an Seilen befestigte Lasten, insbesondere für Theaterpunktzüge

Ansprüche

1. Meß- und Steuereinrichtung für an Seilen befestigte Lasten, insbesondere für Theaterpunktzüge, mit einer Seiltrommel, einer ersten Meßeinrichtung, die die Winkelstellung und/oder Drehzahl der Seiltrommel erfaßt, mit einem die Seiltrommel antreibenden Motor, mit einer zweiten Meßeinrichtung, die optische Markierungen des Seiles abtastet, mit einem Vergleicher, der die Meßergebnisse beider Meßeinrichtungen miteinander vergleicht und mit einer Steuereinrichtung, die in Abhängigkeit vorgegebener Sollwerte der ausgefahrenen Seillänge und der ermittelten tatsächlichen ausgefahrenen Seillänge den Motor steuert, d a d u r c h g e k e n n z e i c h n e t, daß die zweite Meßeinrichtung mehrere optische Meßfühler (21 ... 24) enthält, deren Abstände so gewählt sind, daß gleich-

Eine derartige Meß- und Steuereinrichtung ist in der älteren (unveröffentlichten) deutschen Patentanmeldung P 31 03 708.9-15 der Anmelderin beschrieben.

Aus der DE-OS 14 78 763 ist eine Vorrichtung zur Standanzeige und vorprogrammierten Zielfahrt bei Theatereinrichtungen wie z.B. Dekorationszügen, Punktzügen, Vorhängen, Podien, Bühnenwagen und Drehbühnen beschrieben, bei der der Istwert der ausgefahrenen Seillänge durch eine Schlitzscheibe mit Gebern an der Seiltrommel erfaßt wird. In einem einzigen Rechner für alle überwachten bzw. gesteuerten Theatereinrichtungen werden diese Istwerte mit Sollwerten verglichen, woraus entsprechende Steuersignale für den bzw. die Antriebsmotoren erzeugt werden.

Nachteilig an dieser Vorrichtung ist, daß die Meßgenauigkeit und damit auch die Steuergenauigkeit einerseits durch das relativ grobe Auflösungsvermögen des Winkelcodierers bzw. der Schlitzscheibe mit den Gebern beschränkt ist und daß andererseits durch Belastung hervorgerufene Seildehnungen nicht berücksichtigt werden können. Dies führt einerseits zu unpräzisen Bewegungsabläufen, ungenauen Positionen von beispielsweise Scheinwerfer, Dekorationen etc. und zu ebenfalls unerwünschten Nachsteuerungen. Auch können kritische Dehnungen der Seile infolge von Materialfehlern, überhöhter Belastung etc. bei diesem bekannten System nicht festgestellt werden. Demzufolge besteht auch keine Möglichkeit zu vorbeugenden Maßnahmen gegen Unfälle, die durch etwaigen Seilbruch entstehen.

Aus der Zeitschrift "Bühnentechnische Rundschau" 1979, Heft 2, Seiten 17 bis 20 ist eine Steuereinrichtung für Prospektzüge bekannt, bei der in gleicher Weise wie bei der DE-OS 14 78 763 die ausgefahrene Seillänge durch Winkelschrittgeber, die jedem Zug zugeordnet sind, gemessen wird. Auch hier treten die gleichen, oben beschriebenen Nachteile auf.

Aufgabe der Erfindung ist es, die Meß- und Steuereinrichtung der eingangs genannten Art dahingehend zu verbessern, daß die Meß- und Steuergenauigkeit insbesondere unter Berücksichtigung der Seildehnung verbessert wird.

Diese Aufgabe wird erfindungsgemäß dadurch gelöst, daß die zweite Meßeinrichtung mehrere optische Meßfühler enthält, deren Abstände so gewählt sind, daß gleichzeitig maximal zwei von ihnen jeweils eine Seilmarkierung erfassen.

Hierdurch ist es einerseits möglich, die Seildehnung zu messen, was bei der Messung der Winkelstellung der Seiltrommel nicht möglich ist. Andererseits ist es auch möglich, Zwischenstellungen zwischen den einzelnen Segmenten bzw. Zähnen des Winkelschrittgebers zu erfassen.

Somit ist das Auflösungsvermögen nur noch durch die Breite der Markierungen begrenzt, wobei die tatsächlich ausgefahrene Seillänge, unter Berücksichtigung der Seildehnung gemessen und zur Steuerung verwendet wird und nicht nur die angenommene Seillänge des ungedehnten Seiles. Zusätzlich wird durch die Erfassung der Seildehnung auch die Sicherheit erhöht, da einem drohenden Seilbruch stets eine übermäßige Dehnung vorausgeht, welche erfaßt werden kann.

Das Meß- und Steuerprinzip der Erfindung kann somit überall dort angewandt werden, wo Lasten an Seilen sehr genau bewegt werden sollen, beispielsweise auch bei Aufzügen, Kränen usw.

Nach einer Variante der Erfindung sind die optischen Meßfühler in Seillängsrichtung hintereinander angeordnet, wobei ihr Abstand dem wechselseitigen Abstand der Seilmarkierungen des ungedehnten Seiles plus dem n-fachen eines Inkrementes entspricht, wobei n der ganzzahlige Index des jeweiligen Meßfühlers ist. Die Abstände zwischen den einzelnen Meßfühlern nehmen hierbei kontinuierlich fortschreitend

zu. Nach einer Variante entspricht der Abstand zwischen dem nullten und dem ersten Meßfühler genau dem Abstand zwischen zwei benachbarten Seilmarkierungen, so daß bei ungedehntem Seil diese beiden Meßfühler immer gemeinsam ansprechen. Der Abstand zwischen dem ersten und dem zweiten Meßfühler beträgt dann dem Abstand zwischen zwei benachbarten Seilmarkierungen plus einem vorgewählten Wert (Δl). Ist das Seil in dem Bereich zwischen drei benachbarten Seilmarkierungen, d.h. im Bereich von zwei Meßintervallen um den Betrag Δl gedehnt, so sprechen gleichzeitig der nullte und der zweite Meßfühler an.

Nach einer anderen Variante ist der Abstand zwischen dem nullten und dem ersten Meßfühler bereits gleich der Länge (l) zwischen zwei benachbarten Seilmarkierungen des ungedehnten Seiles zuzüglich des Inkrementes Δl. Bei ungedehntem Seil spricht somit bei entsprechender Lage des Seiles gegenüber dem nullten Meßfühler nur der letztere an, während die übrigen nicht ansprechen.

Nach einer anderen Variante der Erfindung sind die Abstände benachbarter optischer Meßfühler nach Art einer Noniusteilung bezogen auf den Abstand der Seilmarkierungen des ungedehnten Seiles festgelegt.

Die Meßfühler sind vorzugsweise in seitlichen Öffnungen eines Rohres angeordnet, in dessen Inneren ein Stück des Seiles verläuft. Die Meßfühler können hierbei längs einer geraden Linie angeordnet sein, sie können jedoch auch auf einer rings um das Rohr verlaufenden Schraubenlinie angeordnet sein.

Eine besonders gut optisch abtastbare und dauerhafte Seilmarkierung erhält man dadurch, daß die Seilmarkierungen als schraubenlinienförmige Markierung aufgebracht sind, der Art, daß eine Kardeele des Seiles andersfarbig ist als die übrigen Kardeelen. Als besonders günstig bei Stahlseilen

hat sich herausgestellt, die die Markierung bildende Kardeele aus Wolframdraht herzustellen. Dieser unterscheidet sich selbst bei Verschmutzung durch Öl, Staub oder ähnlichem noch deutlich von den übrigen Stahlkardeelen, wobei der Farbunterschied durch Abrieb usw. nicht beeinträchtigt wird.

Nach einer vorteilhaften Weiterbildung der Erfindung enthält die zweite Meßeinrichtung eine den optischen Meßfühlern nachgeschaltete Auswerteeinrichtung, welche durch dynamisches Ansprechen eines vorbestimmten optischen Meßfühlers aktivierbar ist und das gleichzeitige Ansprechen des maximal einen weiteren Meßfühlers erfaßt. Jedesmal wenn eine Seilmarkierung an dem vorbestimmten optischen Meßfühler, beispielsweise dem nullten Meßfühler vorbeiläuft, wird die zweite Meßeinrichtung aktiviert und überprüft, ob zu diesem Zeitpunkt eine weitere Seilmarkierung einem der weiteren Meßfühler gegenüberliegt. Hieraus ist dann die Seildehnung feststellbar.

Bei einer konkreten Ausgestaltung dieses Gedankens weist die Auswerteeinrichtung ein Parallel-Eingabe/Parallel-Ausgabe-Register auf, dessen Aktivier- oder Takteingang mit dem vorbestimmten optischen Meßfühler verbunden ist und dessen Dateneingänge jeweils mit einem der übrigen optischen Meßfühler verbunden sind. Hierdurch wird eine schaltungstechnisch besonders einfache Lösung realisiert. Sobald der vorbestimmte optische Meßfühler, beispielsweise der nullte Meßfühler eine Seilmarkierung erfaßt, wird der Meßvorgang eingeleitet und es wird festgestellt, ob einer bzw. welcher der weiteren Meßfühler zu diesem Zeitpunkt eine Seilmarkierung erfaßt, was dann in den entsprechenden Registerplatz eingeschrieben wird.

Allerdings ist es auch möglich, die Aktivierung des Registers durch ein externes Steuersignal einzuleiten, beispielsweise durch eine Flanke eines Meßimpulses des Winkel-

codierers der ersten Meßeinrichtung. In diesem Falle sind dann alle optischen Meßfühler mit den parallelen Eingängen des Registers verbunden. Die zweite Meßeinrichtung erlaubt dann die Messung von Zwischenwerten zwischen einzelnen Impulsen des Winkelcodierers der ersten Meßeinrichtung.

In dem erstgenannten Fall, bei dem ein vorbestimmter optischer Meßfühler mit dem Aktivier- oder Takteingang des Registers verbunden ist, sieht eine vorteilhafte Ausgestaltung der Erfindung vor, daß dem Register ein Festwertspeicher nachgeschaltet ist, der durch den Inhalt des Registers - ggf. nach einer Code-Umwandlung mittels eines Demultiplexers - adressierbar ist, wobei unter jeder Adresse ein vorgegebener Multiplikationsfaktor abgespeichert ist, und daß ein Multiplizierer vorgesehen ist, dessen Eingänge einerseits mit dem Ausgang des Festwertspeichers und andererseits mit der ersten Meßeinrichtung für die Winkelstellung der Seitentrommel verbunden sind, wobei der Ausgang des Multiplizierers der tatsächlich ausgefahrenen Seillänge entspricht.

Die erste Meßeinrichtung gibt hierbei einen Grundwert für die ausgefahrene Seillänge des ungedehnten Seiles vor, wobei mittels der über die zweite Meßeinrichtung gewonnen Seildehnung ein Multiplikationsfaktor bestimmt wird, mit der der Grundwert der ausgefahrenen Seillänge multipliziert wird, um die tatsächlich ausgefahrene Seillänge unter Berücksichtigung der Dehnung zu erhalten.

Vorzugsweise ist der Festwertspeicher ein programmierbarer Nur-Lese-Speicher (PROM). Hierdurch können die gewünschten Multiplikationsfaktoren einfach programmiert werden, wodurch die Meß- und Steuereinrichtung an verschiedene Aufgabenstellungen angepaßt werden können.

Nach einer Weiterbildung der Erfindung ist ein Vergleicher vorgesehen, dessen Eingänge einerseits mit einem weiteren

Festwertspeicher für eine vorgegebene zulässige Seildehnung und andererseits mit dem Ausgang der zweiten Meßeinrichtung verbunden sind und der in Abhängigkeit von dem Vergleich ein Warn- und/oder Steuersignal erzeugt. Hierdurch können rechtzeitig Gegenmaßnahmen bei übermäßiger Seildehnung, die einer Bruchgefahr vorausgeht, ergriffen werden.

Im folgenden wird die Erfindung anhand eines Ausführungsbeispieles im Zusammenhang mit der Zeichnung ausführlicher erläutert. Es zeigt:

Fig. 1 eine Prinzipskizze eines Ausschnittes der Meß- und Steuereinrichtung; und

Fig. 2 ein Blockschaltbild der Auswerteschaltung der Meß- und Steuereinrichtung.

Gleiche Bezugszeichen in beiden Figuren bezeichnen gleiche Teile.

In Fig. 1 ist ein Seil 10 gezeigt, dessen oberes Ende an einer (nicht dargestellten) Seiltrommel befestigt ist. Das Seil 10 ist hierbei vorzugsweise ein geschlagenes Stahlseil, dessen einzelne Kardeele 12, 13, 14 aus einzelnen Stahldrähten geschlagen sind. Das Seil 10 weist in regelmäßigen Abständen optisch abtastbare Seilmarkierungen auf, welche nach dem in der Fig. 1 dargestellten bevorzugten Ausführungsbeispiel so aufgebracht sind, daß eine Kardeele 11 andersfarbig ist als die übrigen Kardeelen 12, 13, 14. Besonders vorteilhaft ist es, die die Seilmarkierung darstellende Kardeele 11 aus Wolframdraht auszubilden. In Seillängsrichtung gesehen, erscheint die Kardeele 11 jeweils nach einem Abstand 1 wieder an der gleichen Seite des Seiles, so daß bei in gerader Linie angeordneten Meßfühlern der Abstand der einzelnen dort erkennbaren Seilmarkierungen 1 beträgt. Am unteren Ende des Seiles kann eine (nicht dargestellte) Last befestigt werden.

Das Seil 10 verläuft über eine bestimmte Länge innerhalb eines Rohres 20, welches Öffnungen zur Aufnahme optischer Meßfühler 21, 22, 23 bzw. 24 aufweist. Die Anzahl der Meßfühler kann hierbei beliebig sein, je nach Anforderung an die Meßgenauigkeit. Die Mindestanzahl der optischen Meßfühler ist zwei, wobei in diesem Falle dann jedoch nur festgestellt werden kann, ob das Seil eine vorgegebene Dehnung hat oder nicht. In dem dargestellten Ausführungsbeispiel sind die Meßfühler 21 bis 24 in Seillängsrichtung längs einer geraden Linie angeordnet. Natürlich ist es auch möglich, die Meßfühler in anderer Anordnung an dem Rohr 20 zu befestigen, beispielsweise längs einer Schraubenlinie um das Rohr. Auch sei darauf hingewiesen, daß nicht nur eine Kardeele als Seilmarkierung ausgebildet sein muß. Es ist genauso denkbar, mehrere, jedoch nicht benachbarte Kardeelen als Seilmarkierung zu verwenden.

Besonders wichtig ist der gegenseitige Abstand der einzelnen optischen Meßfühler 21 bis 24 bezogen auf den Abstand der Seilmarkierungen. Als generelle Regel gilt, daß der jeweilige Abstand der einzelnen optischen Meßfühler voneinander so gewählt ist, daß maximal zwei Meßfühler jeweils eine Seilmarkierung erfassen können. In dem in Fig. 1 dargestellten Ausführungsbeispiel ist der Abstand wie folgt gewählt: Der Abstand zwischen den Meßfühlern 21 und 22 beträgt 1 + einem Inkrement Δl. Der Abstand zwischen den Meßfühlern 22 und 23 beträgt $1 + 2\,\Delta l$; der Abstand zwischen den Meßfühlern 23 und 24 beträgt $1 + 3\,\Delta l$. Bei einer Anzahl von n Meßfühlern beträgt der Abstand zwischen dem Meßfühler n-1 und dem Meßfühler n dann $1 + (n-1)\Delta l$. 1 ist hierbei stets der Abstand zweier benachbarter Seilmarkierungen.

Bei ungedehntem Seil und unter der Voraussetzung, daß die Anzahl n der optischen Meßfühler und die Größe des Inkrementes Δl so gewählt sind, daß $(n-1)\Delta l$ kleiner als 1 ist, steht beim Vorbeilaufen des Seiles an den Meßfühlern zu jedem Zeitpunkt maximal nur eine Seilmarkierung einem Meßfühler

derart gegenüber, daß sie von ihm erfaßt wird. Wird nun das Seil durch eine Belastung so gedehnt, daß es jeweils auf der Länge l um den Betrag Δl gedehnt ist, so stehen zu einem Zeitpunkt dem Meßfühler 21 und dem Meßfühler 22 jeweils eine Seilmarkierung gegenüber. Den übrigen Meßfühlern steht zu diesem Zeitpunkt keine weitere Seilmarkierung gegenüber, da beispielsweise im Bereich des Meßfühlers 23 die entsprechende Seilmarkierung noch um die Strecke Δl vor dem Meßfühler liegt.

Ist das Seil auf der Strecke l um den Betrag 1,5 Δl gedehnt, so sprechen gleichzeitig nur die Meßfühler 21 und 23 an. Ist das Seil auf der Strecke l um 2 Δl gedehnt, so sprechen gleichzeitig die Meßfühler 21 und 24 an; usw.

Die Ausgänge der optischen Meßfühler 21, 22, 23, 24 usw. sind jeweils mit Eingängen 31, 32, 33, 34 usw. einer Auswerteeinrichtung 30 verbunden. Diese Auswerteeinrichtung wird detaillierter im Zusammenhang mit Fig. 2 erläutert. Im Ergebnis erhält die Auswerteeinrichtung über diese Eingänge 31, 32, usw. das Meßergebnis der optischen Meßfühler und somit das Meßergebnis der "zweiten Meßeinrichtung".

Einem weiteren Eingang der Auswerteeinrichtung 30 werden über die Leitung(en) 36 die Signale der ersten Meßeinrichtung übermittelt, welche die Winkelstellung der Seiltrommel wiedergeben. Aus den Meßwerten der ersten und der zweiten Meßeinrichtung ermittelt dann die Auswerteeinrichtung die tatsächlich ausgefahrene Seillänge, welche dann über die Leitung 38 ausgegeben wird. Zusätzlich können der Auswerteeinrichtung 30 noch über eine Leitung 37 obere und untere Grenzstellungen des Seiles eingegeben werden, so daß die Auswerteeinrichtung sicherstellen kann, daß das Seil nicht über diese Punkte hinaus gefahren wird. Sofern die Auswerteeinrichtung 30 die Steuerung des Antriebsmotors für die Seiltrommel übernimmt, erscheint an dem Ausgang 39 ein Signal, das der Sollgeschwindigkeit des Antriebsmotors ent-

spricht. Schließlich wird auf der Leitung 40 ein Alarmsignal, welches ggf. auch den Motor anhält, ausgegeben, wenn eine übermäßige Seildehnung festgestellt wurde.

Fig. 2 zeigt ein detaillierteres Blockschaltbild der Auswerteeinrichtung 30. Die Ausgänge der Meßfühler 21, 22 usw. werden einem Parallel-Eingabe/Parallel-Ausgabe-Register 41 (Parallel-Input/Output; PIO) zugeführt. Nach einer Variante der Erfindung, bei welcher eine dynamische Messung vorgenommen wird und der optische Meßfühler 21 als Bezugsgröße der Messung gewählt ist, ist der Ausgang des Meßfühlers 21 mit einem Aktivier- oder Takteingang des Registers verbunden, während die übrigen Meßfühler mit den Dateneingängen verbunden sind. Dies hat zur Folge, daß das Register 41 nur dann Daten der Meßfühler 22, 23 usw. annimmt, wenn der Meßfühler 21 angesprochen hat.

Natürlich ist es auch möglich, den Meßzeitpunkt durch ein externes Signal zu bestimmen, das beispielsweise von dem Winkelcodierer für die Trommelstellung abgeleitet ist.

In dem Ausführungsbeispiel der Fig. 2, bei welchem das Register 41 durch ein Signal an dem Meßfühler 21 getriggert wird, kann somit nur ein Registerplatz eine Information, beispielsweise eine logische "Eins" enthalten. Der jeweilige Registerplatz gibt dann die Seildehnung an.

Die Ausgänge des Registers 41 sind über einen Demultiplexer 42 mit Adresseingängen eines Festwertspeichers 43, der vorzugsweise ein programmierbarer Nur-Lese-Speicher (PROM) ist, verbunden. Der Demultiplexer 42 führt hierbei eine Code-Umwandlung durch. In dem Festwertspeicher 43 sind unter jedem Speicherplatz festgelegte Multiplikationsfaktoren abgespeichert, wobei letztlich jedem Ansprechen eines bestimmten Meßfühlers und damit jeder Seildehnung ein bestimmter Wert zugeordnet ist. Diese Multiplikationsfaktoren werden einem Multiplizierer 44 zugeführt, der an seinem anderen Multipli-

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		M/BBB-15-DE	12.8.1982 vB/LÖ

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Ansprüche

1. Meß- und Steuereinrichtung für an Seilen befestigte Lasten, insbesondere für Theaterpunktzüge, mit einer Seiltrommel, einer ersten Meßeinrichtung, die die Winkelstellung und/oder Drehzahl der Seiltrommel erfaßt, mit einem die Seiltrommel antreibenden Motor, mit einer zweiten Meßeinrichtung, die optische Markierungen des Seiles abtastet, mit einem Vergleicher, der die Meßergebnisse beider Meßeinrichtungen miteinander vergleicht und mit einer Steuereinrichtung, die in Abhängigkeit vorgegebener Sollwerte der ausgefahrenen Seillänge und der ermittelten tatsächlichen ausgefahrenen Seillänge den Motor steuert, d a d u r c h g e k e n n z e i c h n e t , daß die zweite Meßeinrichtung mehrere optische Meßfühler (21 ... 24) enthält, deren Abstände so gewählt sind, daß gleich-

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zeitig maximal zwei von ihnen jeweils eine Seilmarkierung (11) erfassen.

2. Meß- und Steuereinrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die optischen Meßfühler (21 ... 24) in Seillängsrichtung hintereinander angeordnet sind und ihr Abstand dem wechselseitigen Abstand der Seilmarkierungen (11) des ungedehnten Seiles (10) plus dem n-fachen eines Inkrementes ($\Delta 1$) entspricht, wobei n der ganzzahlige Index des jeweiligen Meßfühlers ist.

3. Meß- und Steuereinrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Abstände benachbarter optischer Meßfühler (21 ... 24) nach Art einer Noniusteilung bezogen auf den Abstand der Seilmarkierungen (11) des ungedehnten Seiles (10) festgelegt sind.

4. Meß- und Steuereinrichtung nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß die optischen Meßfühler (21 ... 24) in seitlichen Öffnungen eines Rohres (20) angeordnet sind, in dessen Innerem ein Stück des Seiles (10) verläuft.

5. Meß- und Steuereinrichtung nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß die Seilmarkierungen als eine schraubenlinienförmige Markierung aufgebracht sind, der Art, daß eine Kardeele (11) des Seiles (10) andersfarbig ist als die übrigen Kardeelen (12 ... 14).

6. Meß- und Steuereinrichtung nach Anspruch 5, dadurch gekennzeichnet, daß die die Markierungen bildende Kardeele (11) aus Wolframdraht ist.

7. Meß- und Steuereinrichtung nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß die zweite Meßeinrichtung eine den optischen Meßfühlern (21 ... 24) nachgeschaltete Auswerteeinrichtung (30) enthält, welche durch dynamisches Ansprechen eines vorbestimmten optischen Meßfühlers (21) aktivierbar ist und das gleichzeitige Ansprechen des maximal einen weiteren Meßfühlers (22 ... 24) erfaßt.

8. Meß- und Steuereinrichtung nach Anspruch 7, dadurch gekennzeichnet, daß die Auswerteeinrichtung (30) ein Parallel-Eingabe/Parallel-Ausgabe-Register (41) aufweist, dessen Aktivier- oder Takteingang mit dem vorbestimmten optischen Meßfühler (21) verbunden ist und dessen Dateneingänge jeweils mit einem der übrigen optischen Meßfühler (22 ... 24) verbunden sind.

9. Meß- und Steuereinrichtung nach Anspruch 8, dadurch gekennzeichnet, daß dem Register (41) ein Festwertspeicher (43) nachgeschaltet ist, der durch den Inhalt des Registers (41) - ggf. nach einer Code-Umwandlung mittels eines Demultiplexers (42) - adressierbar ist, wobei unter jeder Adresse ein vorgegebener Multiplikationsfaktor abgespeichert ist, daß ein Multiplizierer (44) vorgesehen ist, dessen Eingänge einerseits mit dem Ausgang des Festwertspeichers (43) und andererseits mit der ersten Meßeinrichtung (45) für die Winkelstellung der Seiltrommel verbunden sind, wobei der Ausgang des Multiplizierers (44) der tatsächlich ausgefahrenen Seillänge entspricht.

10. Meß- und Steuereinrichtung nach Anspruch 9, dadurch gekennzeichnet, daß der Festwertspeicher (43) ein programmierbarer Nur-Lese-Speicher (PROM) ist.

11. Meß- und Steuereinrichtung nach einem der Ansprüche 7 bis 10, gekennzeichnet durch einen Vergleicher (47), dessen Eingänge einerseits mit einem weiteren Festwertspeicher (48) für eine vorgegebene zulässige Seildehnung und andererseits mit dem Ausgang der zweiten Meßeinrichtung (41 bzw. 42) verbunden sind und der in Abhängigkeit von dem Vergleich ein Warn- und/oder Steuersignal erzeugt.

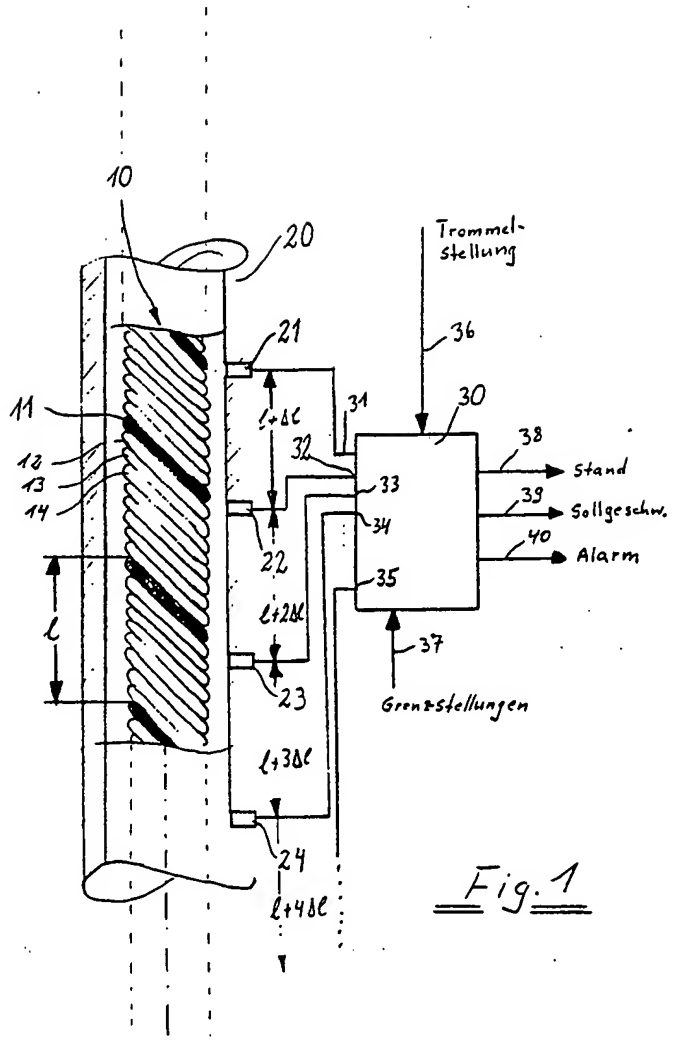

Fig. 1

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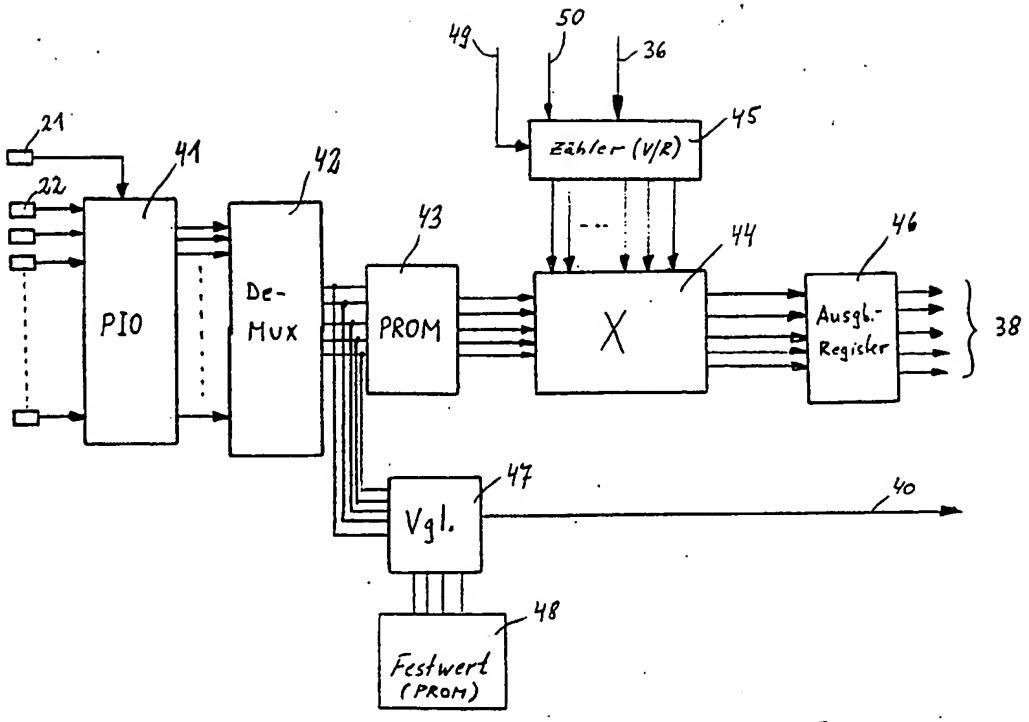

Fig. 2

Europäisches Patentamt

EUROPÄISCHER RECHERCHENBERICHT

0103162

Nummer der Anmeldung

EP 83 10 7865

EINSCHLÄGIGE DOKUMENTE

Kategorie	Kennzeichnung des Dokuments mit Angabe, soweit erforderlich, der maßgeblichen Teile	Betrifft Anspruch	KLASSIFIKATION DER ANMELDUNG (Int. Cl. ³)
A	DE-B-1 030 982 (SIEMENS) * Insgesamt *	1	B 66 C 13/46 A 63 J 1/02
A	FR-A-1 438 839 (STAHLINSTITUT) * Zusammenfassung; Figuren *	1	
A	DE-A-2 649 370 (FA. A. ZILLER) * Anspruch 1; Figuren *	1	

RECHERCHIERTE SACHGEBIETE (Int. Cl. ³)

B 66 C 13/00
A 63 J 1/00
G 01 B 11/00
B 66 B 1/00
B 66 B 5/00

Der vorliegende Recherchenbericht wurde für alle Patentansprüche erstellt.

Recherchenort	Abschlußdatum der Recherche	Prüfer
DEN HAAG	15-04-1985	ZAEGEL B.C.

KATEGORIE DER GENANNTEN DOKUMENTEN

X : von besonderer Bedeutung allein betrachtet
Y : von besonderer Bedeutung in Verbindung mit einer anderen Veröffentlichung derselben Kategorie
A : technologischer Hintergrund
O : nichtschriftliche Offenbarung
P : Zwischenliteratur
T : der Erfindung zugrunde liegende Theorien oder Grundsätze

E : älteres Patentdokument, das jedoch erst am oder nach dem Anmeldedatum veröffentlicht worden ist
D : in der Anmeldung angeführtes Dokument
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B66B7/06

Wire ropes and new suspension means

XP-001092527

V4624
P14+16+18+19+20=(5)
PD 00-09-2001

– Design, use, safety, handling and care, discard criteria –

by Dr.-Ing. Michael Molkow

1 Foreword

If one were to discuss the topic of elevator ropes in front of an international assembly instead of here in Germany it would be necessary to expand on the subject far more, including explanations and reasoning, since Germany and nearby countries in western Europe are the world's uncontested leaders in the field of rope technology.

Elevator ropes with steel cores, slender hoist ropes of down to 8 mm, wire tensile strength grades of up to 1770 N/mm², galvanized elevator ropes, 9-strand ropes and – outside the actual realm of rope technology but closely associated with it – hardened traction sheaves and modern rope terminations (steel terminals and the symmetrical wedge clamp) were indeed introduced here, many years ago but are items which are not known about in a number of large countries outside Europe and in fact are items in which there is little interest in those countries.

2 Designs of steel wire ropes and their use

2.1 Hoist ropes for traction elevators

The normal rope designs, introduced more than a hundred years ago, are those incorporating a fiber core, illustrated in Figures 1, 2 and 3.

With the exception of very special cases these fiber cores will be made of sisal, a natural fiber. These ropes with fibre core have been joined in the meantime by modern, high-performance rope designs shown in Figures 4, 5 and 6.

Please consult Figure 7 to get some idea of the wide variety of special rope designs available on the market.

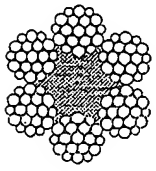

Fig. 1: 6 x 19 Warrington + fiber core

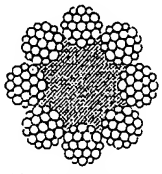

Fig. 2: 8 x 19 Warrington + fiber core

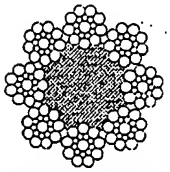

Fig. 3: 8 x 19 Seale + fiber core

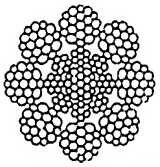

Fig. 4: 8 x 19 Warrington + steel core

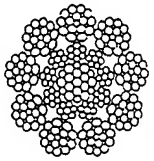

Fig. 5: 9-strand + steel core (trade name DRAKO 300 T)

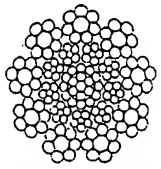

Fig. 6: 9-strand + steel core (trade name Diepa A 160 S)

2.2 Hoist ropes for roped hydraulic lifts

The following designs are suitable for this particular application:

6 x 19 Warrington – FC:	Figure 1
8 x 19 – IWRC:	Figure 4
9-strand – IWRC:	Figure 5

Given preference for this application are ropes with enhanced tensile strength of 1770 N/mm² in versions which are more heavily lubricated.

2.3 Governor ropes

Traditionally selected for the governor rope is the 6 x 19 Warrington – FC (Figure 1) design and occasionally the 6 x 19 – FC version, as well. Being found more ever more frequently, however, at rope diameters of 8 to 10 mm is the 8 x 19 – IWRC (Figure 4) design, this being required by the greater rope loads at higher travel speeds and safety gear which acts in both directions. Worth considering in particularly tall buildings is the 9-strand rope with steel core (Figure 5).

It should be noted here that the lubrication for the governor ropes should be considerably lighter than for the hoist ropes in traction lifts.

2.4 Tensioned compensating ropes

In the simplest case one will use here exactly the same type of rope as for the hoist ropes in any given elevator. Aside from the fact that lubrication for compensating ropes should be considerably heavier than for traction hoist ropes, this being in the interest of increasing their service lives, experience gathered in the past ten years indicates that it would be advisable to depart from this practice. Reasons for selecting a separate design for the compensating ropes are:

- They should be more heavily lubricated, as mentioned above.
- One can use a smaller number of thick-

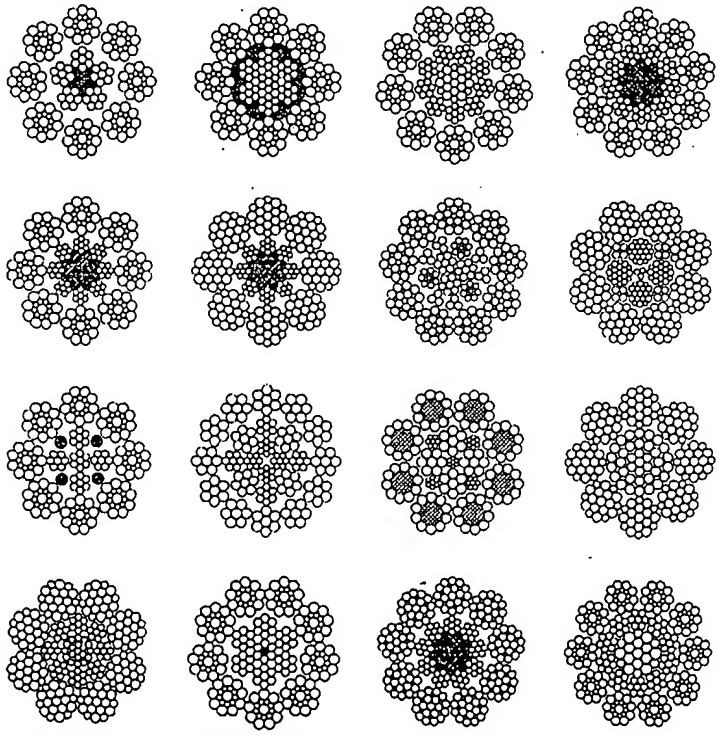

Fig. 7: Variety of special-purpose rope designs

er ropes, reducing the number of tensioning sheaves which will be required..

➢ Since thick ropes at a low D/d ratio (30) are used here, more flexible rope designs with numerous wires should be selected.

➢ Since today two compensating rope pulleys are often arranged in tandem, rope twisting is possible due to inexact alignment. Ropes with steel cores show a tendency to suffer early damage at the low rope tensions found in this application.

➢ Ropes with natural fiber cores, at the prevailing low tension values, react to changes in humidity within the hoistway (construction phase, monsoon rains, seasonal changes etc.) with considerable changes in length. Synthetic fiber cores have proven their value as a solution to this problem.

2.5 Advice for identifying the ideal choice

Given this diversity of designs and the associated price differences, putting forth certain suggestions regarding rope selection is appropriate.

Table 1 shows the applications for which the rope designs previously mentioned (and other designs) are suitable and commonly used, along with the minimum and maximum diameters in each case.

Delving into the many and varied differences in elevator rope behavior – which will be dependent upon the lay, strand design, number of strands, type of core etc. – would go far beyond the scope of the present discussion. Assistance in selecting the ideal rope design for both the hoist ropes and the compensating ropes, listing their advantages and disadvantages, is offered, for example, by the Inform 9 bulletin published by the DRAKO company. If one disregards the column entitled "Recommended DRAKO elevator rope" in Table 4 of that publication, then it provides an impartial "rope cookbook" which can be consulted when selecting ropes for systems which do not impose extreme demands.

3 Maintenance

In questions of maintenance one can only offer some well-known words of advice – because they have been proven correct in many years of use:

➢ When changing the rope without changing the sheaves, the groove diameters at the sheaves are to be checked and the sheaves should be replaced or reworked where groove size is less than the nominal rope diameter (for steel core ropes) or less than nominal rope diameter less 1% (for 8 x 19 + FC ropes).

➢ Check and readjust rope tensions more frequently at the beginning and occasionally later.

➢ Use a suitable lubricant (ask the rope manufacturer or apply your own experience) to re-lubricate the hoist ropes and compensating ropes.

Re-lubrication is not necessary if the fingers take on a slightly greasy film of grime when wiped over the ropes. The results of this test will, however, have to be uniform for all the ropes, all along the entire length of the section which passes over sheaves. If re-lubrication is carried out, then this should be carefully metered, adhering to the rule of thumb: "Rather a bit too little at first than too much right at the beginning." This is work which should be carried out by your most experienced service person. Governor ropes should not be re-lubricated unless the pertinent operating instructions prescribe this specifically.

4 Discard

TRA 102, the section of the Technical Rules for Elevators, which describes the compulsory elevator inspections, continues to be in force and places elevator ropes – in regard to the number of wire breaks which mandate retirement – in mechanism group 5 m as defined in DIN 15 020 (comperable to M.8 of ISO 4309). Part 2 of that standard establishes the discard criteria for lang lay and ordinary lay ropes, depending upon the number of wires in the outer strands.

Rope design	Common rope diameter range in mm			
	Application			
	Hoist ropes for traction elevators	Hoist ropes for roped hydraulic elevators	Governor ropes	Tensioned compensating ropes
6 x 19 Warr. – FC (Figure 1)	Often used for small goods lifts, otherwise rare 6.5 ÷ (16)	6.5 – 13	6.0 – 8	13 – 19
6 x 25 Filler – FC	–	–	–	13 – 19
8 x 19 Warr. – FC (Figure 2)	8 – 16	–	–	13 – 19
8 x 19 Seale – FC (Figure 3)				
8 x 21 Filler – FC				
8 x 25 Filler – FC	–	–	–	13 – 22
8 x 19 – IWRC (Figure 4)	6.8 – 18	6.5 – 13	8 – 10	–
9-strand – IWRC (Example: Figs. 5 and 6)	8 – 22	8 – 13	8 – 10	–
6 x 36 Warr. – Seale – FC	–	–	–	22 – 36

Table 1: Usage and common diameters for various rope designs

Now this standard does, in fact, expressly exclude traction drives and rope drives for elevators in general, but the many years of experience amassed for the definitions in TRA 102 have demonstrated the obvious suitability of almost all the discard criteria cited in DIN 15 020, Part 2, for elevator rope operations as well.

Since, however, DIN 15 020 was written with a view toward ropes used in cranes or crane-like devices, it is of course necessary to keep the peculiarities of elevators in mind:

➢ Breakage of a rope or even of all the ropes, because this practically never happens, is not the situation which is of primary concern. A rope must exhibit extreme damage before it will fail completely due to fatigue.

➢ Instead, and well in advance of actual rope failure, strand breaks are to be avoided since even a single broken strand, undetected within the enclosed hoistway and machine room, can involve real hazards for the entire elevator. This is a situation quite different from that found in a crane.

➢ Wear is much more severe than in a crane due to the grooves which are V-shaped or severely undercut.

➢ As opposed to the crane, several ropes are used in parallel, with the attendant advantages – or disadvantages.

➢ The service lives of elevator ropes are usually far greater than for crane ropes. In this long service period it sometimes happens that the effort devoted to maintenance and monitoring for uniform rope tension and sheave wear dwindles over time.

➢ Due to the large number of fatigue bendings which the ropes experience in elevators even minor mechanical damage to the ropes, resulting from pinching, kinks or the like, will after some period of time induce wire and strand breaks which are limited to a small portion of one rope and thus are difficult to find.

➢ Wide variations in diameter along the length of a rope, which can appear in the 8 x 19 – FC designs made up by "exotic" rope manufacturers in particular, in conjunction with close groove tolerances and high pressure levels can also result in breaks concentrated in such isolated areas. This increases the hazard of strand failure even though there are often no signs of fatigue in the other ropes.

➢ As regards the degree of diameter reduction at which a rope should be retired – irrespective of whether and how many wire breaks might be found – Paragraph 3.4.2.f of DIN 15 020, Part 2, specifies replacement at a 10 % reduction in diameter. This is, in the author's often-expressed opinion, far too much. One should discard the rope at 6 % below nominal diameter which means, taking a 13 mm rope as the example, replacement should be made at 12.2 mm. Elevator professionals should also remember here that at such a considerably smaller rope diameter the sheaves will be subjected to excessive wear and, even if

that does not appear to be particularly compelling, the traction capacities in the system will decline considerably where diameters are reduced this much and where undercut grooves are employed.

As a summary of all the good advice regarding the determination of the end of the service life which is as late as possible and as safe as necessary, the following warning is appropriate:

The evaluation of the interplay of ongoing fatigue bending and tension – tension fatigue damage and damage due to wear, corrosion, mechanical damage and the influence of extreme elevator operating parameters is only possible by assessing all changes in the ropes and this has to be done by an experienced observer. This is certainly asking quite a lot and it would help if this person had serviced the system for a number of years so as to be able to follow the progress of wear and damage.

5 Suspension means of the future

This is certainly something which gives wing to the imagination. Every elevator professional will immediately recall the ultra-tall buildings often planned, some a mile high, with their elevators of corresponding heights. A moment's reflection brings us to the conclusion, however, that by the time the passengers have reached the topmost level at, let's say, the 450th floor, they will have changed lifts about four times due to the constraints imposed by traffic-handling strategies. Consequently the ascent heights of the individual lifts are quite within the range which has already been achieved with steel-roped lifts. And whether one actually intends to plan for a firefighting lift reaching all the way up to the 450th floor is subject to serious doubt.

Consequently it was certainly not the lack of *lightweight* hoist ropes which has been a hurdle to constructing such buildings in the past.

Moreover, the capacities of steel wire elevator ropes have not been entirely exhausted.

5.1 High-strength elevator ropes made of steel wire

Building upon advances in wire-making technology in recent years a good wire rope manufacturer today can supply steel wire elevator rope permitting the construction of elevators of up to about 600 m in height. For reasons of hoistway space utilization these will probably be double-deckers with a capacity of about 2 x 20 passengers. Rope diameters will be from 22 to 26 mm. Wire tensile strength grade, with very careful selection of the wire lots, will be from 1960 to 2000 N/mm², within a very narrow tolerance range. Thus one has surpassed the allowances of EN 81.

At such great lift heights, however, the usual loading mix, comprising certain percentages for tension-tension fatigue, fatigue bending and pressure, is shifted unilaterally in the direction of pressure and tension-tension fatigue. Thus the mechanisms which tend to damage the rope and shorten rope service life will probably no longer lie within the usual boundaries. In order to make "life as easy as possible" for the rope it will be necessary to build traction sheaves and countersheaves which are significantly larger than usual.

5.2 Current new types of suspension means

If, then, these tall buildings are not the driving force behind the costly and risky development of entirely new types of suspension means (and which elevator or rope manufacturer has reaped, beyond prestige and experience, any financial rewards success worth mentioning in undertaking such special construction projects?), which other motivations are there for pursuing this work? A listing of desirable properties – by no means complete – would be as follows. Please consider that not all the properties could be realized simultaneously.

Technical properties for the suspension means:

- Low weight per meter
- Simple manufacturing process
- High breaking force
- Low elongation, both elastic and permanent
- Good coefficient of friction between the rope and the sheave
- High flexibility

Technical properties during operation:

- Easy installation
- Simplified monitoring of the suspension means
- Largely free of maintenance requirements
- Long service life

As well as the non-technical properties:

- Low price
- Exclusivity (patented design).

Which of these properties are deemed to be essential and, derived from that, the identification of target groups for which elevators fitted with such new suspension means designs are to be developed is not the subject of the present article.

A few of the properties and characteristics, as far as these are known, are listed below for the two new types of suspension means currently attracting attention in the market.

5.2.1 Aramid rope manufactured by Schindler

Ropes made of aramid, a man-made fiber which does not melt but instead carbonizes, and that only at temperatures well beyond 400 °C, have been around for about 30 years. Until production of ropes using a special type of process met with success about eight years ago, these designs were always unsuitable for the high fatigue bending rates which are common in normal cranes and especially in elevators.

Figures 8 and 9 show the difference.

Fig. 8: Aramid rope using a traditional design

Fig. 9: Aramid rope in the new design

Ropes engineered in accordance with the new concept shown in Figure 9 exhibit an extraordinarily long service life. In the fatigue bending machine they achieved bending cycle figures which were more than 30 times those for an average steel wire rope of the same diameter (an 8 x 19 Warrington design with fiber core) under comparable conditions.

But this would not have been enough since certain properties of the aramid fibers had in the past made it necessary to jacket the rope with polyurethane. This rendered impossible the inspection techniques previously used to determine the end of service life. Incorporating a number of additional, electrically conductive carbon fibers in the rope, as a second step, then permitted use of this new rope technology in fields such as elevator engineering which impose such stringent demands in regard to safety. The carbon fibers are more sensitive to bending than the rope's actual load-carrying elements and their progressive failure – detected by special electronics which measure conductivity – is an indicator for gradual and ongoing fatigue in the rope. This occurred reliably in all the fatigue bending tests carried out to date and in all the numerous installations in trial towers and actual elevators, as well.

Some additional information: Start of development: about 1993. Participating bodies: Schindler, Ebikon, with its research facilities – Cousin Frères, France, as the inventor of the original rope design – German TÜV Southwest as the notified body – The Conveyance Technology Institute at Stuttgart as the research facility in particular for the fatigue bending tests – The Gustav Kocks company as consultant and manufacturer of these aramid ropes over the last 4½ years and today licensee for production of the aramid elevator ropes for the Schindler company as well as licensee for further development, production and sale of the aramid ropes for all non-elevator applications.

At this opportunity one should also mention the original inventor and promoter of the idea of using this type of rope in elevators: Mr. Claudio de Angelis, employed by Schindler since 1993.

The first patents for this invention had already been submitted by 1994.

The manufacture of these ropes will be launched shortly in a manufacturing

facility in Dortmund, established jointly by Schindler and Kocks. This step was taken because production to date had been split. The first phase in manufacture was at Cousin Frères, while the actual rope production was at DRAKO. This combination did not provide sufficient capacity for the high demand.

A few technical details on the novel aramid ropes:

- Number of rope variations tested to date: 50
- Rope diameters tested to date: 6, 8, 12.5, 13
- Breaking strength of a 12.5 mm rope: 40 to 100 kN; 49 kN as an elevator rope
- Elongation at failure: 2.1 to 3.8 %
- Jacket variations: 4, including fire-retarding compounds
- Weight (12.5 mm rope): approx. 15.5 kg/100 m
- Coefficient of friction (authoritative for engineering calculations): 0.26 depending upon the polyurethane compound
- Figure 10 shows the cross-section of an aramid elevator rope.

The spread in the specified values is due to the highly divergent properties of the various rope designs.

Table 2 reproduces an attempt to make a comparative evaluation.

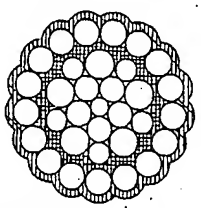

Fig. 10: Cross-section of an aramid elevator rope

The potentials of the aramid rope have not as yet been fully exploited. A patent prepared by the Schindler company, for example, provides for a tandem unit as shown in Figure 11 in which the torques in this special rope design cancel each other out. This gives considerably greater tensile strength while at the same time reducing costs.

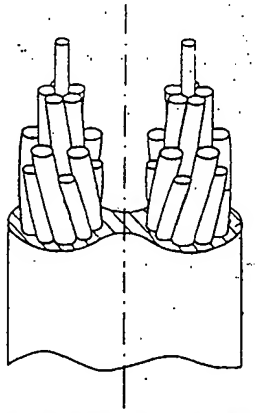

Fig. 11: View of a tandem rope made of aramid

Property / usage / factor	Suspension means		
	Aramid rope	Polyurethane belt	Steel rope for comparison
Weight	0.45	0.84	Rope of identical minimum breaking strength = 1.0 times
Minimum breaking strength	2.18 (= 1 : 0.45)	1.19 (= 1 : 0.84)	Rope of same weight = 1.0
Coefficient of friction	μ = 0.26/0.34 x groove factor	No information	μ = 0.1/0.2
Stretch	Considerably greater	Considerably less	8 x 19 + FC is reference value
D/d	20.8	33	≥ 40
Sheave dimensions, current systems (3 ropes)	260 mm diam. x 80 mm	100 mm diam. x approx. 260 mm	approx. 400 mm diam. x 80 mm
Rope speed, m/s	> 8	3.2 up to now	> 12
Fatigue bending life in test machine	Up to 30 times reference value, depending on design	3 times reference value (manufacturer's specification)	8 x 19 Warr. + FC under identical conditions (25 D/d) = reference value
Tall lifts: Compensating chain?	No	Yes, probably	Yes
Price	about 2.5 times	about 2.5 times (estimated)	Rope of identical breaking strength = 1.0 times
Exclusivity? (patented design)	Yes	Yes	No
Installation	Easy (weight!)	Easy	Normal
Rope monitoring	Electronic continuity testing. Permanent monitoring as well.	Magnetic inductive. Permanent monitoring probably not possible.	Visual inspection; permanent monitoring not possible
Endangerment by fire	No hazard by fire outside the elevator shaft	No hazard by fire outside the elevator shaft	No hazard by fire outside the elevator shaft
Deflection of ropes possible	Yes	No	Yes
Care and maintenance?	No	No	Yes

Table 2: Comparison of steel ropes with the new hoist equipment

5.2.2 Polyurethane belt made by the Otis and ContiTech companies

A few words on the development history are appropriate.

On occasion of the 1998 Hannover Industrial Trade Fair the ContiTech company, known to insiders in conjunction with conveyer belts, appeared before the public with the idea of a flat belt – plastic or rubber on the outside enclosing steel wires as the tensile element – for use as a substitute for rope.

In February of 1998 Otis in the United States had a polyurethane belt patented for use as suspension means in elevators (the European patent for Otis was published on December 20, 2000).

The close cooperation between Otis and ContiTech made possible the remarkably short development period through to market introduction.

As shown in Figure 12, this concept comprises twelve tensile members made of high-strength steel wire embedded in a polyurethane jacket which exhibits grooves on one side.

Manufacturer: ContiTech, Dannenberg. Manufacturer of the tensile elements: The Bekaert company in Belgium, a renowned manufacturer of steel wire and steel wire tensile elements.

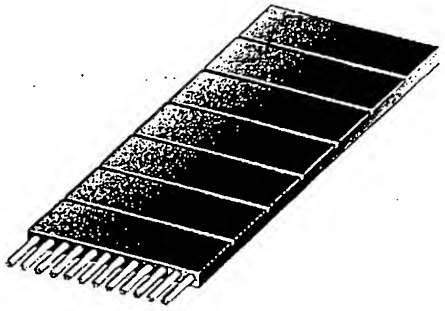

Fig. 12: Polyurethane belt

Some technical specifications, in so far as these are available to the author:

- Dimensions: 30 x 3 mm
- Tensile elements: 12 elements made up of seven 7-wire strands
- Metallic cross-section: 14.89 mm²
- Calculated breaking strength: 32 kN; actual breaking strength: approx. 37 kN
- Weight: 22 kg/100 m

Table 2 shows an attempt to set up a comparative evaluation.

5.2.3 Comparison of properties and application potentials for new suspension means

The listing in Table 2 reflects the author's opinion, based on the information available to him at present. The comparisons are usually referenced to a steel rope of comparable breaking strength or of the same diameter or of the same weight.

6 Summary

They have been around for so long – elevators using steel ropes – and in spite of all that problems do still surface from time to time, whether they be in manufacturing, during installation or simply due to an elevator concept which is too high-strung. Consequently one might well doubt whether everything will go smoothly with the new suspension means which said to have become ready for market in such a short period of time.

But seven years of development and more, with three years of field experience for the elevator concept using the aramid rope, is not exactly a short period of time and in the case of the PU belt a broadly based and intensive testing program covering many aspects in parallel has shortened the development time.

In addition and in contrast to steel rope, these new concepts are not available for every possible and impossible elevator configuration and assembly crew but only for certain elevator systems which have been thoroughly tested using these suspension means and installed by specially trained installation and service personnel.

The remarkably parallel development stories for the two innovative suspension designs introduced here demonstrate that an idea could quite easily originate outside the industry but that the subsequent road to market readiness can be covered only in cooperation with a major elevator company. This is because the elevator should be able to fully utilize these novel characteristics and this means that, once a new idea for suspension equipment is born, it then becomes necessary to first develop an elevator concept exhibiting the similar degree of innovation.

Only after this has transpired can the suspension means be optimized and, together with the new elevator design, be tested in actual operation.

Here it is necessary to learn to question standard assumptions and approaches that seem perfectly natural and customary if we wish to bring to economic success (and impeccable safety levels) something which is as radically different as these innovative suspension ideas.

Among other accomplishments worthy of note in this context is that the TÜV has passed with flying colors its "trial by fire" as a notified body.

(Lecture at the 2001 Heilbronn Lift Conference)

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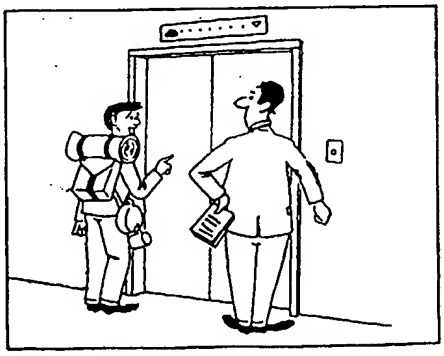

„Meine letzte Fahrt mit diesem Aufzug dauerte vier Tage!"

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UNITED STATES OF AMERICA

Date of mailing *(day/month/year)* 25/04/2003	
Applicant's or agent's file reference OT-4935	**FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/US 02/ 40242	International filing date *(day/month/year)* 16/12/2002
Applicant OTIS ELEVATOR COMPANY	

1. [X] The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

Filing of amendments and statement under Article 19:
The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

When? The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

Where? Directly to the International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland
Fascimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. [ ] The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. [ ] **With regard to the protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

[ ] the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

[ ] no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Further action(s):** The applicant is reminded of the following:

Shortly after **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90*bis*.1 and 90*bis*.3, respectively, before the completion of the technical preparations for international publication.

Within **19 months** from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within **20 months** from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer Amélie M^ller

Form PCT/ISA/220 (July 1998)

NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions respectively.

INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international pbulication. Furthermore, it should be emphasized that provisional protection is available in some States only.

What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

When? Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

How? Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

What documents must/may accompany the amendments?

Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped),whether

(i) the claim is unchanged;

(ii) the claim is cancelled;

(iii) the claim is new;

(iv) the claim replaces one or more claims as filed;

(v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."

2. [Where originally there were 15 claims and after amendment of all claims there are 11]:
"Claims 1 to 15 replaced by amended claims 1 to 11."

3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."

4. [Where various kinds of amendments are made]:
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

"Statement under article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international appplication is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, where upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
OT-4935		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/US 02/ 40242	16/12/2002	19/12/2001
Applicant		
OTIS ELEVATOR COMPANY		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 5 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

[ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

[ ] contained in the international application in written form.

[ ] filed together with the international application in computer readable form.

[ ] furnished subsequently to this Authority in written form.

[ ] furnished subsequently to this Authority in computer readble form.

[ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

[ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

[ ] the text is approved as submitted by the applicant.

[X] the text has been established by this Authority to read as follows:

LIFTING BELT WITH EXTERNAL MARKINGS

5. With regard to the **abstract,**

[ ] the text is approved as submitted by the applicant.

[X] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 2

[X] as suggested by the applicant.

[ ] because the applicant failed to suggest a figure.

[ ] because this figure better characterizes the invention.

[ ] None of the figures.

Box III TEXT OF THE ABSTRACT (Continuation of item 5 of the first sheet)

A load bearing assembly (26) in an elevator system includes a plurality of discernable markings (40) on an external surface of the assembly. A monitoring device includes at least one detector (30) that detects locations of the markings along the length of the assembly. Changes in spacing between markings provides an indication of belt (26) loading conditions and provides an ability to determine a condition of the belt relative to whether a replacement of the belt may be necessary. A variety of markings and a variety of detecting arrangements are disclosed.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 02/40242

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B66B7/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B66B G01B D07B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 073 728 A (OLSEN ERIC G ET AL) 13 June 2000 (2000-06-13)	1,4,9, 14,16, 20-22
Y	abstract; figures 1-8	2,3,8, 12,17,19
	column 1, line 30-43	
Y	EP 0 103 162 A (BAYERISCHE BUEHNENBAU GMBH) 21 March 1984 (1984-03-21)	2,8,12, 17,19
X	page 3, line 20-30; figure 1	20-22

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 April 2003	25/04/2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Janssens, G

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 02/40242

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
Y	MOLKOW M: "WIRE ROPES AND NEW SUSPENSION MEANS DESIGN, USE, SAFETY, HANDLING AND CARE, DISCARD CRITERIA" LIFT REPORT, VFZ VERLAG, DORTMUNT, DE, vol. 27, no. 5, September 2001 (2001-09), pages 14,16,18-20, XP001092527 ISSN: 0341-3721	3
A	figure 12	1

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 02/40242

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6073728 A	13-06-2000	US 5992574 A	30-11-1999
		EP 0849208 A1	24-06-1998
		JP 10182036 A	07-07-1998
		US 5890564 A	06-04-1999
EP 0103162 A	21-03-1984	DE 3230213 A1	23-02-1984
		AT 27134 T	15-05-1987
		DE 3371497 D1	19-06-1987
		EP 0103162 A2	21-03-1984